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Diaper Wetness Annunciator System

by

H. George Pires

ROHM & MONSANTO, P.L.C.
Attorneys at Law
660 WOODWARD AVENUE, SUITE 1525
DETROIT, MICHIGAN 48226
TELEPHONE (313) 965-1976
TELECOPIER (313) 965-1951

[0001] # Diaper Wetness Annunciator System

[0002] ## Relationship to Other Application

[0003] This application claims the benefit of Provisional United States Patent Application Serial No. 60/499,191, filed on September 2, 2003, the disclosure of which is incorporated herein by reference.

[0004] ## Background of the Invention

[0005] FIELD OF THE INVENTION

[0006] This invention relates generally to systems for determining a physical environmental condition from a remote location, and more particularly, to a simple and economical system for announcing a wet diaper condition at a remote monitor.

[0007] DESCRIPTION OF THE RELATED ART

[0008] There is a need for a system that announces to a care giver that a diaper needs to be changed. Babies, for example, wet their diapers any time during the day or night, and without regard to whether they are in or out of their homes. There is a need for parents to be notified when this happens. Child care centers that tend to a number of babies simultaneously will change diapers at regular intervals to be on the safe side. Identifying and notifying the care giver that a diaper actually needs to be changed would save unnecessary changing of diapers and effect a reduction in diaper and labor costs. There is also a need in hospitals to check diapers worn by patients, many of whom are not able to notify the care givers that diaper changes are necessary. Hospital personnel, therefore, must make repeated checks on the diapers, which not only is an unpleasant task, but also consumes the limited human resources of the hospital.

[0009] Several attempts have been made in the prior art to identify wet diapers. The simplest known systems use one or more substances, such as a chromophore, that change color when

wet. Other known arrangements contain transducers that change conductivity when wet and transfer this information to a passive electronic circuit that in turn is interrogated wirelessly by an external transmitter/receiver. The external transmitter/receiver in such known arrangements must be located within a few feet of the diaper. Other methods employ electronic transmitters located near the patient and connected by wires to the diaper. Still others have the transmitter on the body of the patient connected by wires. All of these systems are characterized by one or more disadvantages, such as inconvenience, high cost, or limited range of effectiveness, rendering them unacceptable in a large multi-patient environment, or where extended distances exist between the patients or a baby, and a monitoring station. For instance, the change in color concept still requires hospital staff to visit and examine the patient on a regular basis. The passive electrical system has a limited range and is inconvenient. Methods that require the patient to be wired to a separate unit are equally unacceptable because they require staff to make electrical connections or to change batteries. Moreover, additional wiring is uncomfortable to the patient, and limits his or her mobility.

[0010] It is, therefore, an object of this invention to provide a diaper wetness detecting system that employs a direct electrical connection between the wetness detector and a conveniently transportable transmitter.

[0011] It is another object of this invention to provide a diaper wetness detecting system that can be used to identify specific ones of wet diapers in a hospital ward, child care center, or other location where a plurality of individuals in close relation to one another wear diapers that need to be monitored.

[0012] ## Summary of the Invention

[0013] The foregoing and other objects are achieved by this invention which provides a system for monitoring the wetness condition of a diaper. In accordance with the invention, there is provided a sensor coupled to the diaper, the sensor having a first predetermined electrical characteristic when the associated diaper is dry and a second predetermined electrical characteristic when the associated diaper is wet. A detachable transmitter is installable on the diaper. When installed on the diaper, the detachable transmitter is electrically coupled to the sensor. In its operation, the detachable transmitter has a quiescent mode when the sensor is characterized by the first predetermined electrical characteristic and a transmission mode when the sensor is characterized by the second predetermined electrical characteristic. When in the transmission mode, the detachable transmitter transmits electromagnetic energy signals. A receiver is provided for receiving the electromagnetic energy signal transmissions from the detachable transmitter when the detachable transmitter is in the transmission mode.

[0014] In one embodiment of the invention, there is provided a coupling arrangement for simultaneously coupling the detachable transmitter onto the diaper and forming the electrical coupling with the sensor. The coupling arrangement includes a snap arrangement formed of first and second detachably engaging portions, the first engaging portion being installed on the diaper and electrically coupled to the sensor, and the second engaging portion being installed on the detachable transmitter and electrically coupled thereto. In a particularly advantageous embodiment of the invention, the first engaging portion is a female conductive portion of the snap arrangement and the second engaging portion is a male conductive portion of the snap arrangement. The conductive elements preferably are rustproof.

[0015] In a further embodiment, the detachable transmitter is provided with a visual indicator responsive to the detachable transmitter being in the transmission mode. Therefore, the system permits visual inspection by a care giver without the need to have access to the receiver or to check manually for wetness.

[0016] It is preferred that the detachable transmitter be contained within a hermetically sealed housing. Thus, the detachable transmitter can easily be washed and disinfected, and reused, thereby effecting significant savings in system cost. Also, it is preferred in certain embodiments that the receiver be portable so that it can be carried about in the pocket or on the belt of the care giver. Such a portable receiver may be battery operated.

[0017] In a still further embodiment of the invention, the detachable transmitter issues an identifier code when in the transmission mode, the identifier code being encoded in the electromagnetic energy signals. The receiver is arranged to produce a human readable indication associated with the detachable transmitter in response to the identifier code. In this manner, a care giver can readily identify the particular patient or child that is in need of a diaper change.

[0018] In accordance with a further system aspect of the invention for monitoring the wetness condition of a diaper, there is provided a sensor associated with the diaper, the sensor having a first predetermined electrical characteristic when the associated diaper is dry and a second predetermined electrical characteristic when the associated diaper is wet. A detachable transmitter is installed on the diaper and coupled electrically to the sensor, the detachable transmitter having a quiescent mode responsive to the sensor when the associated diaper is dry and a transmission mode responsive to the sensor when the associated diaper is wet. In addition, the detachable transmitter transmits a unique identification code within

electromagnetic energy signals that are transmitted when the detachable transmitter is in the transmission mode. A receiver receives the electromagnetic energy signal signals from the detachable transmitter and issues a perceptible indication, the perceptible indication being responsive exclusively to the identification code transmitted by the detachable transmitter.

[0019] In one embodiment of this further aspect of the invention, the electromagnetic energy signals are in the radio frequency range. Of course, other forms of electromagnetic energy may be used in the practice of the invention, including electromagnetic energy signals in the infrared and/or other frequency ranges. Irrespective of the nature of the electromagnetic energy signals being used in the practice of the invention, the receiver can be configured to be portable, as previously noted.

[0020] Also as previously noted, there is provided a coupling arrangement for simultaneously coupling the detachable transmitter onto the diaper and forming an electrical coupling between the detachable transmitter and the sensor. Conventional metallic or otherwise electrically conductive snaps can be used for this purpose.

[0021] In accordance with a still further aspect of the invention, there is provided a system for monitoring a plurality of diapers, each diaper being worn by a respective one of a plurality of patients. A plurality of sensors is provided, each associated with a respective one of the diapers. Each sensor has a first predetermined electrical characteristic when the associated diaper is dry and a second predetermined electrical characteristic when the associated diaper is wet. A plurality of independent transmitters are coupled to each of an associated sensor, each transmitter having a quiescent mode when the associated diaper is dry and a transmission mode when the associated diaper is wet. Each such transmitter, when in a transmission mode, transmits independent bursts of electromagnetic energy signals at

respective intervals. There is additionally provided a receiver for receiving the electromagnetic energy signal transmissions from each of the plurality of independent transmitters that is in its transmission mode, each electromagnetic energy signal transmission containing information responsive to a transmitter identification code of the respective transmitting independent transmitter.

[0022] In one embodiment of this aspect of the invention, there is further provided a transmitter identification code generator in each of the plurality of independent transmitters for generating the associated transmitter identification code. In an advantageous embodiment of the invention, there is provided a programming station for programming each of the independent transmitters with a patient identification code responsive to the identification of a respectively associated patient. A control processor processes the information contained within each transmission.

[0023] In accordance with another aspect of the invention, there is provided a system for monitoring a plurality of diapers, each diaper being worn by a respective on of a plurality of patients. A plurality of sensors, each associated with a respective one of the diapers, is included within the system. Each sensor has a first predetermined electrical characteristic when the associated diaper is dry and a second predetermined electrical characteristic when the associated diaper is wet is provided. A plurality of independent transmitters are each coupled to an associated one of the sensors. Each transmitter has a quiescent mode when the associated diaper is dry and a transmission mode when the associated diaper is wet. Each transmitter in a transmission mode transmits independent bursts of electromagnetic energy signals at respective intervals. A programming station is used to program each of the independent transmitters with an identification code responsive to the identification of a

respective patient. Additionally, there is provided a receiver for receiving the electromagnetic energy signal transmissions from each of the plurality of independent transmitters that is in its transmission mode. Each electromagnetic energy signal transmission contains information responsive to the identification code of the associated transmitting independent transmitter. A control processor is used to process the information in each transmission.

[0024] The present invention consists essentially of four items, the first of which is a passive humidity sensor that changes from a high impedance to a low impedance state when the diaper is wet. In addition, this sensor is electrically connected to a pair of metallic or otherwise conductive button snaps (resembling clothing snaps) situated about half an inch apart and located on the outside of the diaper in the front near the top.

[0025] The second item is a small hermetically sealed and fully encapsulated unit about an inch square and a quarter of an inch thick containing two metal snaps designed to mate with the two snaps on the front of the diaper. This second unit, a programmable transmitter module, is relatively inexpensive in cost but not low enough to be considered completely disposable with each diaper. The unit is expected to have a battery life of a year or two. In practice, when the diaper requires changing, the care giver will first unsnap the transmitter module from the soiled diaper and snap it on to the new one. The guardian will then remove the soiled diaper and discard it, along with the disposable humidity sensor. Lastly the guardian installs the new diaper, which has the transmitter module attached, and completes the operation in exactly the same manner as if the transmitter module were not present. With the exception of having to remove the transmitter module from the old diaper and installing it on a fresh one, the guardian is not burdened with any additional tasks. Guardians are very

willing to trade off the slight inconvenience of having to transfer the completely sealed and unsoiled transmitter module to a new diaper, against having to undertake the unpleasant task of having to make several checks for wet diapers for every one that requires changing or leaving a baby unattended with a wet diaper that can cause rash or other medical problems.

[0026] The transmitter module contains an inexpensive battery and an electronic chip. None of the components, including the battery, is accessible to the outside, or replaceable. The unit consumes essentially no power from its internal battery as long as the humidity sensor item is dry. Thus, the battery life when the humidity sensor is dry is essentially the shelf life. When the humidity sensor detects moisture, the transmitter module emits short bursts of radio frequency signals for a period or about half a second and repeats this approximately every minute or two as long as it remains connected to the wet diaper. Under normal use it is envisaged that the diaper will be changed within a few minutes, so the power drain on the transmitter module will be very low, allowing the module to remain operative for several years with normal use. All modules transmit on the same frequency, but each has a different code embedded in the transmission. Short bursts of transmissions separated by relatively long wait periods serve to prevent signals from overlapping.

[0027] The third item is a receiver tuned to the frequency of the transmitter modules and capable of receiving and reading signals from any receiver module within its range. There may be several forms of receivers. Possibly the most popular one would be a small battery operated portable unit about two inches square carried on the belt of the guardian and capable of emitting a beep when it receives a signal from its dedicated transmitter. In most cases there would be only one transmitter within range. If there are several transmitters in close proximity, such as in hospitals, conflict between simultaneous, and therefore garbled,

transmissions is avoided by several constraints. First of all there are only a small number of diapers that will be wet at the same time. Secondly since the transmitter modules are not synchronized for transmission times, and since each sends out very short bursts with long wait periods in between bursts and that only when a wet diaper is detected, it is extremely unlikely that the transmissions of two or more transmitter modules will be coincident in time, even if two or more diapers get wet at the same time. However there is always the possibility that two or more transmitters will send overlapping signals. There are algorithms available that permit decryption of garbled simultaneous transmissions. But even if the receivers are not so equipped they may simply retransmit the garbled signals allowing software in the computer to differentiate between garbled and valid signals. Or else the computer may simply wait until it receives a non-garbled signal. In day care centers the receiver unit will simply wait until it gets a set of clear signals if two diapers get wet at the same time. The transmitters, however, can be manufactured to have random quiescent periods between the transmission burst that vary slightly from one another. Thus, if two transmitters transmit simultaneously, they will not remain in synchrony for future transmissions.

[0028] The fourth item of this system is a computer that may be connected via cables or the power lines using commands that are similar to the widely used X-10 system. This will only be used in hospitals or large installations. The computer will interrogate the receiver units independently and absorb the information it receives. It will have the intelligence to differentiate between valid transmissions and invalid garbled ones, such as if two or more transmitter modules happen to overlap their transmissions. As mentioned earlier, since there is no synchronization between the various transmitter modules, it is unlikely that any two transmitter modules will continue to send time coincident bursts of signals.

[0029] As briefly mentioned earlier, the transmitter module may be programmable. It contains a non-volatile memory that can be programmed by the computer unit using a special adaptor that has a three pin contact unit (in addition to the two snaps mentioned earlier) on side of the module. The module snaps into place on the adaptor. Before use, the module is programmed with an individual code, delivered via the three pin contact unit and assigned by the computer. This links the code with the name of the patient.

[0030] When the computer receives a signal that indicates one of the diapers is wet, the data it receives contains a code that is specific to one particular transmitter, and the patient is thereby identified. If the patient is not at the bed, the care giver will need to locate the patient in the ward, but such would not create undue hardship since the care giver will know the identity of the patient. If a garbled unrecognizable code is received, in the unlikely event that two transmitter modules have transmitted at the same time, the computer will quickly recognize that fact. It will reject that garbled code and wait for the next transmission that will in all probability not be garbled, because the two reporting diapers are not synchronized.

[0031] Hospitals will in all probability discard the transmitter modules at the end of a patient's stay, even though it is not necessary to do so, because the modules can easily be sterilized.

[0032] Another, and probably much larger application for this product is use of the system by parents to monitor the condition of diapers. For this use, battery operated receivers are designed and constructed to permit them to be carried on the parent's belt. The receivers will vibrate, emit a sound, or provide a visible signal whenever the diaper is wet. The receivers can be carried by the parent their person anywhere in the house or outdoors. For the general

consumer application such as this, there is no need for a computer. The portable receiver will be matched with the transmitter module in the following manner:

[0033] The portable receiver will have a "learn" switch, illustratively in the form of a button switch. Each of the transmitters will be programmed at manufacture with a different code, using a very large number of combinations that will avoid repetition. When the transmitter module is squeezed, a built-in switch is activated, causing the transmitter to transmit. If the "learn" button is depressed simultaneously, the receiver unit learns the code of the transmitter. Thenceforth the receiver unit will notify the parent only upon receipt of a signal from that particular transmitter. If the parent loses either the transmitter or the receiver he or she can readily can acquire a replacement for the lost item and re-program the receiver in the manner described herein.

[0034] An advantage of this system is that the radio frequency radiation is always very low powered and limited to the fraction of a second during each of the few bursts of transmission of the transmitter module.

[0035] In accordance with yet another aspect of the invention, there is provided a system for indicating the wetness condition of a diaper. The system has a sensor coupled to the diaper, the sensor having a first predetermined electrical characteristic when the associated diaper is dry and a second predetermined electrical characteristic when the diaper is wet. A confirmatory element that is externally accessible, and has a third predetermined electrical characteristic which remains unchanged when the diaper exhibits either the first or the second predetermined electrical characteristics, is also provided.

[0036] In one embodiment, the confirmatory element is a resistor. In a specific illustrative embodiment of the invention, the resistor has a resistance value of approximately ten thousand ohms.

[0037] In accordance with another aspect of the invention, there is provided system for transmitting electromagnetic energy, the system having a transmitter having first, second, and third electrical terminals for coupling with first and second external devices. The first external device is coupled to the first and second electrical terminals and has first and second electrical characteristics responsive to environmental conditions. The second external device is coupled to the second and third electrical terminals and has a substantially constant electrical characteristic. The transmitter operates to have a quiescent mode when the first external device exhibits the first electrical characteristic, and a transmission mode when the first external device exhibits the second electrical characteristic and the substantially constant electrical characteristic of the second external device is present across the second and third electrical terminals.

[0038] The transmitter transmits electromagnetic energy when in the transmission mode, and when the second predetermined electrical characteristic is present across the first and second electrical terminals simultaneously with the substantially constant electrical characteristic of the second external device being present across the second and third electrical terminals.

[0039] The first and second electrical characteristics of the first external device constitute different levels of impedance responsive to environmental humidity. The substantially constant electrical characteristic of the second external device constitutes a predetermined electrical impedance, which may be a predetermined electrical resistance value.

[0040] Brief Description of the Drawing

[0041] Comprehension of the invention is facilitated by reading the following detailed description, in conjunction with the annexed drawing, in which:

[0042] Fig. 1 is a simplified schematic representation of a diaper equipped with a humidity sensor;

[0043] Fig. 2 is a simplified schematic representation of the diaper of Fig. 1 with a transmitter module attached thereto;

[0044] Fig. 3 is a simplified schematic representation of a transceiver unit;

[0045] Fig. 4 is a simplified schematic representation of a generalized computer arrangement;

[0046] Fig. 5 is a simplified schematic representation in block and line form that is useful to describe the functioning of a transmitter module;

[0047] Fig. 6 is a simplified schematic representation of a programming adaptor;

[0048] Fig. 7 is a simplified schematic representation of a battery operated portable receiver;

[0049] Fig. 8. is a simplified schematic representation of a transmitter module; and

[0050] Fig. 9 is a simplified schematic representation of a diaper equipped with a humidity sensor and a confirmatory resistor.

[0051] Detailed Description

[0052] Fig. 1 is a simplified schematic representation of a diaper 1 equipped with a humidity sensor 2. The diaper has two metal snaps 4 that, in this embodiment, are similar to the ones conventionally used on clothing. The snaps are connected to the humidity sensor by means of two fine enameled copper wires 3 embedded in the fabric of the diaper so they do are not visible from the outside and do not make physical contact with the body of the person

wearing the diaper. The diaper, in this specific illustrative embodiment of the invention, contains the female portion of the snaps.

[0053] Fig. 2 is a simplified schematic representation of diaper 1 of Fig. 1 with a transmitter module 5 attached to it. Module 5, is only about an inch square. Module 5 is, in this embodiment, hermetically sealed and without hidden pockets capable of harboring germs. It is made of a plastic material capable of being sterilized. In this specific illustrative embodiment of the invention the module contains the male portion of the snaps. It also contains a set of three small closely spaced metallic buttons 10 that are used to deliver an individual code to a non-volatile memory (not shown) as will be described hereinbelow.

[0054] Fig. 3 is a simplified schematic representation of a transceiver unit 30. This transceiver unit can be placed in reasonably close proximity to the wearer of the diaper, illustratively on the order of 100 feet. In practice, there would be several of these transceiver units distributed in the hospital ward. Each transceiver unit 30 has a receiver 9 tuned to the common carrier frequency of the modules and a communicator 8 that communicates with a computer 33 shown in Fig. 4.

[0055] Fig. 4 is a simplified schematic representation of a personal computer 33. There are several ways in which one or more transceiver units 30 can communicate with computer 33. Referring for the moment to Fig. 3, each transceiver unit 30 has an associated connector 6 that can be daisy chained with the well-known RS422 port of computer 33. Alternatively, other communications protocols may be employed, including, for example, the common X-10 system, or any of several forms of wireless communication.

[0056] Fig. 5 is a simplified schematic representation that shows certain details of a transmitter module 34. A pair of snaps 4 are disposed on the outside of the transmitter

module. The snaps are shown to be connected to switch 16, which in this specific illustrative embodiment of the invention is a MOS (metal oxide silicon) device well known to the electronic industry. Switch 16 exhibits a high impedance to its internal switch apparatus when there is a high resistance or open circuit between the snaps. When the diaper gets wet, a low impedance is present between the snaps. This changes the conductivity of switch 16, to a low impedance. Steady power is thus delivered from the battery, 11, to a timer 15. The power lasts as long as the diaper is wet and enables the timer to operate.

[0057] Timer 15 in turn is designed to send power to a transmitter 14 in short bursts. The timer is also a MOS device requiring extremely low power. It remains in an "on" condition as long as humidity sensor 2 is in the wet state. Timer 15, which is formed of MOS components common well known to those in the electronic industry, is designed to present a low impedance, in this specific illustrative embodiment of the invention, for about half a second at intervals of a minute or two. The periodic low impedance is similar in effect to the pushing of a button switch on a remote control device. It provides power to transmitter 14 and to a non-volatile code memory, 12. Transmitter 14 is designed to transmit the code from the memory 12 using a transmitter antenna 13, which, because of the high carrier frequency, is very small and embedded in the walls (not shown) of a plastic module (not shown) that houses the transmitter module.

[0058] Transmitter module 34 operates in a manner similar to a remote control "clicker" of the type used to open the doors or trunk of an automobile (not shown). Code memory 12 is connected to three metal tabs 20 that are shown to be accessible on the outside of the transmitter module. The purpose of these tabs is to enable code memory 12 to be programmed with a unique individual number, by means of programming adaptor 35,

described hereinbelow in connection with Fig. 6. Programming is achieved using methodology well known to the electronic industry. Two resistors 17, serve to protect the transmitter module against electrostatic charges that may develop in the handling of the unit.

[0059] Fig. 6 is a simplified schematic representation of a programming adaptor 35. As shown, programming adaptor 35 contains a rectangular depression 22 in the same shape as transmitter module 34. The transmitter module is accommodated in rectangular depression 22. Additionally, there are provided two snaps 23 within rectangular depression 22, the snaps being similar to snaps 4 described above on diaper 1. There are also provided three contacts 21 that communicate electrically with metal tabs 20 on the transmitter module 34. Programming adaptor 35 is, in this specific illustrative embodiment of the invention, electrically connected at its printer port 24 to printer port 34 of computer 33 shown in Fig. 6.

[0060] In an actual application of this technology in a hospital, the care giver would snap one of the transmitter modules into the programming adaptor and enter the name or the patient on the computer screen in the space provided (not shown). The computer would then load a specific code into the code memory to establish a relationship between the patient and the newly entered code. The care giver would then take the programmed transmitter module and attach it to the diaper being used for that patient.

[0061] Later, when the diaper becomes wet, the humidity sensor energizes the transmitter module, which in turn transmits a code to one of the transceiver units. Whenever any one or more of the transceivers receives a wet diaper call, it communicates that fact to the computer. The computer has the intelligence to evaluate the data and to determine whether the codes are valid. The computer additionally analyzes the data to determine the name of

the patient requiring attention. If a garbled code is received, as might be the case when two transmitters transmit simultaneously, the computer will wait for additional transmissions.

[0062] Fig. 7 is a simplified schematic representation of a battery operated portable receiver 36. In consumer applications with parents and babies and day care centers, the transmitter modules could be programmed differently than as described above. In such embodiments, each transmitter would be manufactured with a respective unique permanently programmed code. The numerical combinations would be so large that they would not be repeated for many years. In this embodiment, the three programming tabs described above would be absent from the transmitter modules. Instead the transmitter modules would have a small internal switch (not shown) that would be activated by squeezing the transmitter module. This switch would force the module to transmit.

[0063] The battery operated portable receiver 36 shown in Fig. 7, has a learn button 25. When learn button 25 is depressed at the same time as the transmitter module is squeezed, the receiver would learn the code it is receiving. That process individualizes the transmitter-receiver combination. A similar method could be used to program a multi-unit receiver (not shown) used in day care centers.

[0064] Fig. 8. is a simplified schematic representation of a transmitter module 37. Elements of structure that bear correspondence to those already discussed are similarly designated. In this specific illustrative embodiment of the invention, module 37 has three snaps, 42A, 43A, and 44A disposed on the outside of the transmitter module and designed to make electrical contact with respective snaps 42, 43, and 44 disposed on the diaper 38 (see, Fig. 9). When installed on the diaper, snap 42 contacts snap 42A, snap 43 contacts snap 43A, and snap 44 contacts snap 44A. This specific illustrative embodiment of the module of the invention

module has two additional elements over that described in Fig. 5, specifically a microcontroller 50 and a measurement arrangement 51.

[0065] In Fig. 8, snaps 43A and 44A function as described above in connection with snaps 4 of Fig. 5. Referring to Fig. 8, in order to prevent unwanted transmissions which could occur when the transmitter is not attached to the diaper and terminals 43A and 44A erroneously detect a characteristic that would indicate a wet diaper (for instance when it is being washed), a confirmatory check is conducted by the transmitter module. This confirmatory check consists of measuring the electrical characteristic between terminals 43A and 44A, using any one of the measurement techniques well-known in the electronics industry, before tripping the timer 15.

[0066] The sequence of operation is as follows. When the switch detects a change in characteristics between the snaps 43A and 44A microcontroller 50 is notified of the event. The microcontroller then commands measurement arrangement 51 to measure the resistance between snaps 42A and 43A. If the microcontroller deems the measurement to be within the specified limits (within a predetermined tolerance of the expected value), the microcontroller triggers timer 15, in the same manner as described earlier and this results in the sequence of events that are identical to those described earlier. For simplicity of explanation, protective resistors 17, which are not essential to the operation of the unit, have not been described in connection with this specific illustrative embodiment of the invention.

[0067] Fig. 9 is a simplified schematic representation of a specific illustrative embodiment of the invention showing diaper 1 having a humidity sensor 2 and a confirmatory resistor 41. Elements of structure that bear correspondence to those already discussed are similarly designated. Confirmatory resistor 41 is of a predetermined value and is connected between

terminals 42 and 43. In this embodiment, this component is a resistor but such is not intended to limit the invention. The measured element may instead be a capacitor (not shown), an inductor (not shown), or a combination of such elements.

[0068] Although the invention has been described in terms of specific embodiments and applications, persons skilled in the art may, in light of this teaching, generate additional embodiments without exceeding the scope or departing from the spirit of the claimed invention. Accordingly, it is to be understood that the drawing and description in this disclosure are proffered to facilitate comprehension of the invention, and should not be construed to limit the scope thereof.